

Sensitivity of the Simulation of Thermally-Driven Circulations in an Idealized Valley to Planetary Boundary Layer Parameterizations

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MOTIVATION

Project ASTER - Atmospheric boundary-layer modeling over complex terrain

Aims:

- evaluate the model's sensitivity to turbulence and land surface parameterizations or their input parameters.
- identify modeling issues in mountainous terrain related to the turbulence and land surface parameterizations that have a large impact on the forecast

Methodology:

- series of RANS simulations in an idealized 3D valley-plain topography
- comparison with a LES, assumed as the benchmark
- use of different statistical methods to identify the parameters most affecting model results (see next presentation by Dario Di Santo)

Model Setup



• WRF model

- 1-km resolution RANS with different PBL schemes
- 100-m resolution LES as reference
- $\Delta z = 5$ m close to the surface, $\Delta z = 130$ m at 1500 AGL
- Boundary conditions: periodic W and E, symmetric N, open S
- Coordinates: 45°N, 11°E
- Period: 06 UTC 20 March 18 UTC 21 March, first 12 h not analyzed

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RESULTS: VALLEY FLOOR

Valley floor - h 6 Valley floor - h 6 3000 -3000 LES ---- LES ACM2 ACM2 BOULAC - BOULAC EEPS - EEPS 2500 -GRENIER 2500 GRENIER KEPS KEPS MYNN2 MYNN2 MYNN3 MYNN3 ONSE QNSE 2000 2000 -SHIN-HONG SHIN-HONG Height [m AGL] - YSU YSU Height [m] 1500 1500 1000 -1000 -500 -500 -0 -10 -8 8 10 272 288 292 276 280 284 296 V-component [m s⁻¹] Potential temperature [K]

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Results: Valley Floor

Valley floor - h 18 Valley floor - h 18 3000 3000 LES ---- 1 FS ACM2 — ACM2 BOULAC - BOULAC EEPS — EEPS 2500 -GRENIER 2500 GRENIER KEPS - KEPS MYNN2 MYNN2 MYNN3 MYNN3 QNSE QNSE 2000 2000 -SHIN-HONG SHIN-HONG Height [m AGL] - YSU YSU Height [m] 1500 1500 1000 -1000 500 -500 0 0 280 10 272 276 284 288 292 296 -10 8 Potential temperature [K] V-component [m s⁻¹]

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RESULTS: VALLEY FLOOR - POTENTIAL TEMPERATURE ERROR



Results: Valley Floor - V-Component Error



Results: Western Slope



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Results: Western Slope

Western slope - h 12





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CONCLUSIONS

- along-valley wind: higher variability between the RANS in the nighttime phase
- slope wind: small differences between the RANS both during daytime and nighttime
- potential temperature: on the valley floor smaller differences with the LES during daytime
- significant differences in the simulation of the PBL height

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Aster Alpinus